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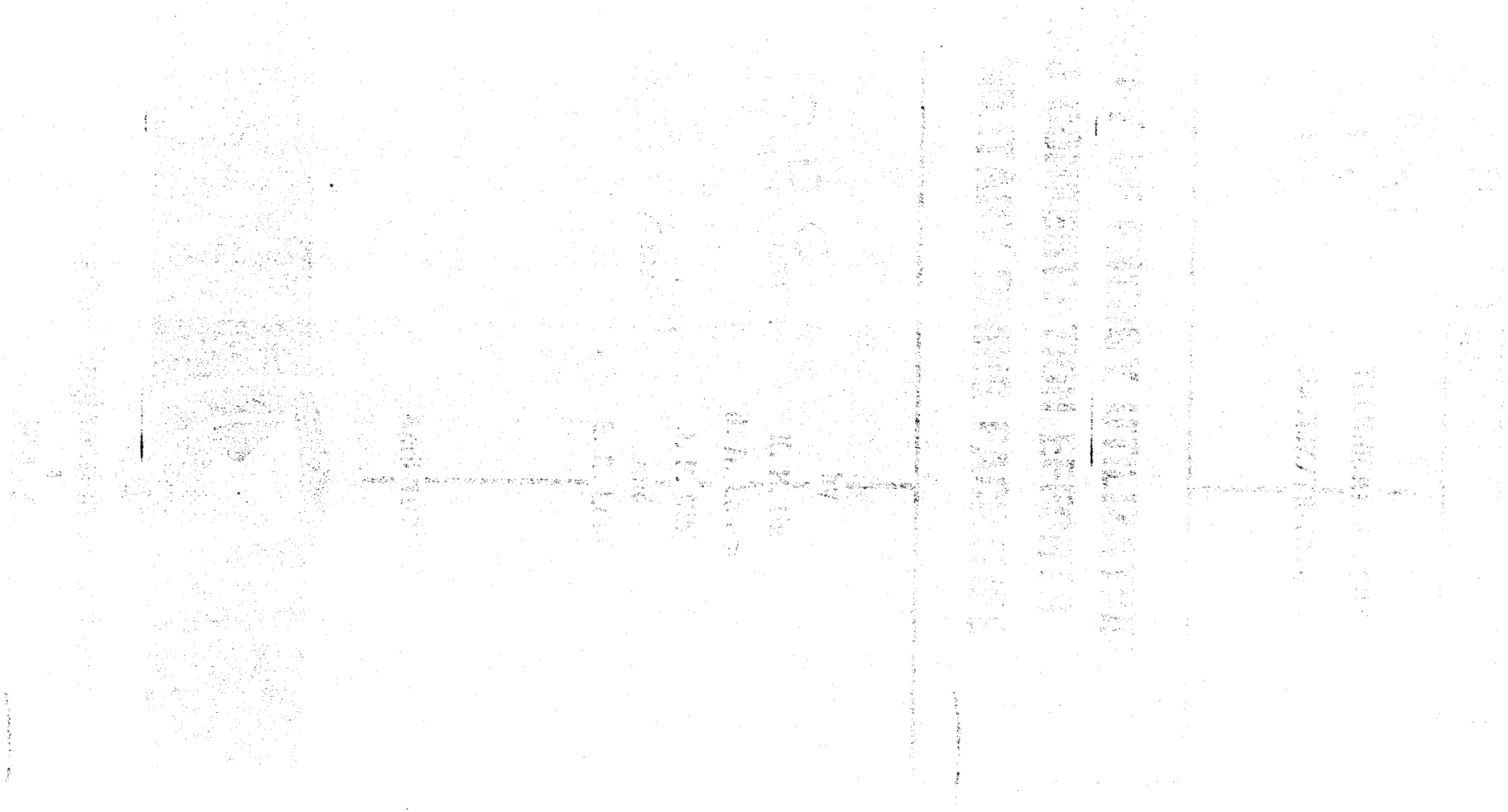

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This report presents the results of a questionnaire survey of 111 military installations consisting of 720 dining facilities in energy utilization and local efforts in energy conservation. Ovens as a group have been identified as the highest energy consuming item as compared with other major cooking equipment. Exhaust hoods have been identified as one of the longest operating items. As a result of energy shortages, local adaptive efforts in energy conservation are in practice in some military installations. There is no

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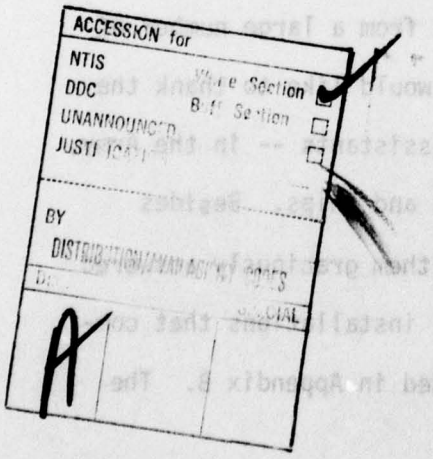
systematic in-depth program to bring about an achieavable goal in maximum energy conservation. However, with the energy utilization information available from the survey, plus measures on energy conservation in food service operation available in publications, possible cost savings resulting from recommended conservation steps are enumerated. These conservation steps not only can save energy, but will also greatly reduce equipment breakdown as a result of not leaving equipment in idling condition more than necessary.

PREFACE

The Army, Navy, and Defense Logistics Agency have requested a study of Energy Conservation in Military Food Service Operations (JSR AND 7-1). The overall objective of the energy conservation study is to reduce energy consumption in military food service operations. An initial step in this program, as reported here, has been a survey of food service operations to: define the spectrum of energy-consuming equipment in actual use; identify local efforts to conserve energy; and obtain suggestions from service elements relative to energy conservation. The survey was conducted by means of a written questionnaire supplemented by phone conversations and visits to selected installations. The survey includes 111 military installations, which encompass 720 individual dining facilities. Also included in this report is a summary of prevailing energy-conservation recommendations from published sources.

A survey study of this scope cannot be conducted without a great deal of assistance and cooperation from a large number of individuals. Specifically, the authors would like to thank the 111 food service officers -- and their assistants -- in the Army, Marine Corps, and Navy land installations and ships. Besides filling out the questionnaires, many of them graciously answered questions by mail or telephone. The 111 installations that completed the questionnaire survey are listed in Appendix B. The

authors also would like to thank CPT T. Piazza, former Commanding Officer of the Navy Food Service Systems Office; and Mr. N. Graziano of the same office; and MAJ E. Cox of Headquarters, Marine Corps; for their support in sending out questionnaires to their respective installations; Mr. L. Klarman, Management Information Systems Office of NARADCOM, for his diligent efforts in programming and data analyzing; and our secretary, Ms. Hilma Laakko, for her continuous assistance in typing and editing the manuscript.



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SURVEY OF ENERGY UTILIZATION AND CONSERVATION EFFORTS AT MILITARY DINING FACILITIES

I. Executive Precis

1. The information and data presented in this report are the result of a questionnaire survey of 111 Army, Navy, and Marine Corps installations consisting of 720 dining facilities and serving 312,987 military personnel. The objectives were: (a) to identify equipment items that are large users of energy either because of their number, hours in use, design features, or all of these and (b) to assess local efforts and suggestions for energy conservation.

2. Ovens have longer hours in operation than any other major cooking equipment. In fact, the hours of usage of ovens are more than twice as long as those of either deep-fat fryers or griddles. This is true both in electric and gas cooking equipment, and it is also true in Navy land installations and Navy ships, as well as Marine Corps and Army installations. In military installations, ovens as a group can be considered to be the highest energy-consuming items as compared with other major cooking equipment.

3. The average operating time of exhaust hoods is 12 hours a day. However, some exhaust fans on Navy ships are being operated 24 hours a day, due to varying demands at sea and operating conditions on shipboard.

4. There is an average of 5.2 units of refrigerators/freezers

in a dining facility, and each unit is in operation 24 hours a day. There are 294 air-conditioned dining facilities against 366 dining facilities that are not air-conditioned. All dining facilities surveyed on board ships were air-conditioned and, in most cases, the cool air came from central air-conditioning systems.

5. This survey also reflects the fact that the Navy land and Marine Corps installations use more electric than gas cooking equipment; whereas, in Army installations the opposite is true -- the gas cooking equipment far outnumbers the electric. Navy ships have no gas cooking equipment; they depend entirely on electric power.

6. As a result of energy shortages, some local adaptive efforts in energy conservation are in practice in some military installations. The majority of these installations reported that they turn off equipment, lights, and water when not needed. They also cited management personnel involvement in energy conservation. However, there is no systematic in-depth program to bring about an achievable goal in maximum energy conservation.

7. About 25% of the military installations surveyed indicated that they had problems with equipment consuming an excessive amount of energy. As indicated in the survey, most of their problems stemmed from such causes as old equipment, malfunctioning equipment, slow reporting and request for repair, and slow response from the Public Works Department of Facilities Engineers to such requests.

(Maintenance personnel claim that some equipment parts have long delivery dates, and sometimes other emergency repairs have to be taken care of first.)

8. An overwhelming majority of the installations surveyed offered suggestions on how energy savings can be achieved best. The most frequently mentioned suggestions were: (a) use more energy efficient equipment, (b) turn off unnecessary equipment and lights, (c) provide training programs for food service personnel, (d) improve upkeep and maintenance programs, and (e) stress close supervision by key personnel.

9. Metering and monitoring of energy consumption are necessary in an energy conservation program. None of the installations surveyed had installed and monitored all the necessary metering devices. Many expressed willingness to participate in conducting tests on energy conservation measures. However, upon actual contact and visits, it was learned that utilities in many dining facilities were shared by other nonfood related activities, such as barracks, offices, and recreational centers; and therefore it would be difficult or almost impossible without great expenditures to rewire and rearrange the piping to isolate the specific energy consuming items of food service equipment of the dining facilities. However, in recently built military dining facilities there are some separate structures that offer an opportunity to install meters for monitoring energy usage. The installation of meters should, therefore, be incorporated in the building program of new dining facilities.

10. Our survey shows that ovens, especially in bake shops, are held at idling temperatures when not in use, based on a mistaken belief that excessive time is required for preheating. Our laboratory tests show that a bakery oven like the Middleby-Marshall oven can be preheated to a baking temperature of 425°F (218.3°C) in 26 minutes, while small ovens require only 15 minutes for preheating. Ovens could be automatically preheated by installing electric timers to turn them on, and the cost of the timers could be recovered through lower energy bills in a matter of days (see Table 13). Also, by not holding ovens at idling temperatures for long periods of time, equipment breakdowns could be minimized.

11. Exhaust hoods have also been identified as one of the long operating items. Our survey indicates that some exhaust hoods are being left on overnight. Consideration should be given to the installation of electric timers to turn off exhaust hoods that do not have automatic shut-offs. Exhaust hoods should be turned off by timers no later than two hours after the kitchen work has been completed.

12. Pertinent literature on energy conservation in food service operations has been reviewed. A summary of recommendations on no-cost and/or low-cost energy conservation measures is presented in this report.

13. From the energy data collected in this survey, the energy

consumption of major food service equipment and possible cost savings are calculated. The necessary conservation steps to be taken to achieve cost savings are recommended.

II. Introduction

The joint services of Army, Navy, and Defense Logistics Agency have requested a study of Energy Conservation in Military Food Service Operations (JSR AND 7-1). The need for such a study is well presented in the Defense Logistics Agency's program requirement (DLA 6-2) which states:

"In view of the global energy crisis or shortages affecting most of the current energy sources, the rising cost of energy and potential for a shortage of available energy for conducting a totally operational military force, it is deemed essential that every effort be made to reduce the energy demands of military food service equipment. Energy reductions in large military installations could be significant and materially enhance the achievement of DOD and national energy conservation goals."

A. Objectives.

The overall objective of the energy conservation study is to reduce energy consumption in military food service operations.

1. The Army program requirement (USA 7-4) states that initial studies should be focused on identifying those items having

the highest energy consumption and frequency of use. Identified items could then be analyzed to determine feasibility of reducing energy requirements.

2. The Navy program requirement (USN 7-3) requests that surveys be made to estimate the degree to which domestic energy conservation measures affect functioning of current feeding systems and that evaluations be made of local adaptive efforts already in use as a result of energy shortages. Surveys could also be made through literature review and/or on-site observations, as appropriate. Operational studies should then be followed for the purpose of determining equipment/facility design, utilization, and maintenance factors which offer potential for effecting energy conservation.

3. The Defense Logistics Agency requirement (DLA 6-2) requests that measures/methods/modifications/test methods for food service equipment be developed and that recommendations for changes in procurement specifications or on-hand equipment modifications be provided.

B. Methods and Procedures.

In view of the combined requirements of the Army, Navy, and DLA for gathering information on current equipment energy data in Military Food Service Operations, a survey questionnaire was designed by NARADCOM and sent to the various military installa-

tions (see Appendix A). Appendix A consists of two parts. Part A was devoted to identifying equipment having the highest energy consumption and frequency of use. Each dining facility in the various installations was requested to fill out part A.

Part B was devoted to determining local adaptive efforts on conservation measures already in use as a result of energy shortages, problems encountered in conservation measures, and suggestions on ways and means for future energy conservation. Each installation was requested to fill out Part B.

The survey questionnaires were sent to Army installations directly from NARADCOM; to Naval land installations and ships from the Navy Food Service Systems Office, Washington, D.C.; and to Marine Corps installations from Headquarters, Marine Corps, Washington, D.C. The Air Force was not a sponsoring Service of the energy conservation study; therefore, there are no Air Force installations included in this study. The data obtained from these survey questionnaires were computerized and subsequently analyzed.

III. Review of Pertinent Literature

As a result of the energy situation, numerous publications have appeared offering tips and advice on energy savings. Only selected literature pertinent to overall energy conservation in food service operations is summarized in this report. Energy reclamation and recovery as well as new energy sources, such as solar, wind, geothermal, etc., are beyond the scope of this report, and therefore are not included in this review.

A. Recommendations on Energy Conservation in General

The American Petroleum Institute, Edison Electric Institute and Office of Energy Conservation,[1] Department of the Army,[2,3,4] Federal Energy Administration,[5,6,7] Food Service Marketing

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[1] American Petroleum Institute, Edison Electric Institute and Office of Energy Conservation. The Energy Challenge, What Can We Do? 1974.

[2] Department of the Army. Army Energy Program AR 11-27. July 1975.

[3] Department of the Army. Food Service and Related Equipment AR 420-55. May 1976.

[4] Department of the Army. Energy Conservation in Dining facilities (Telecommunications) DALO-TST-F. 3 February 1977.

[5] Federal Energy Administration. Guide to Energy Conservation for Food Service. October 1975.

[6] Federal Energy Administration. Energy Policy and Conservation Act Fact Sheet. May 1976.

[7] Federal Energy Administration. Tips for Energy Savers FEA/D-77/212. August 1977.

Magazine,[8,9,10] Pizza Hut Restaurants,[11] Hardee's Food Systems, Inc.,[12] Midwest Research Institute,[13] National Restaurant Association,[14] Nation's Restaurant News,[15] U.S. Army Troop Support Agency,[16] and others[17,18,19,20] offer suggestions and recommendations on energy savings in food service operations.

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[8] Food Service Marketing. A Master Plan to Energy Management. Part 1 Food Service Marketing, P. 43-44. August 1975.

[9] Food Service Marketing. A Master Plan for Energy Management. Part 2 Food Service Marketing, P. 20. September 1975.

[10] Food Service Marketing. A Master Plan for Energy Management. Part 3 Food Service Marketing, P. 43-44. October 1975.

[11] Food Service Marketing. Energy Plan for Pizza Hut Restaurants. Food Service Marketing, P. 16. August 1976.

[12] Hardee's Food Systems, Inc. Hardee's Energy Monitoring Program. 1974.

[13] Midwest Research Institute. Energy Management and Energy Conservation Practices for the Food Service Industry. MRI Project No. 3985-D. December 1974.

[14] National Restaurant Association. Check list for Energy Control and Conservation.

[15] Nation's Restaurant News. Energy - Conservation Trends. Nation's Restaurant News, P. 33. 11 April 1977.

[16] U.S. Army Troop Support Agency. Introduction to Energy Conservation in Enlisted Personnel Dining Facilities. Directorate of Food Service. June 1977.

[17] Karman, D.J. How to Select and Specify Time Controls to Save Energy. Specifying Engineer, P. 80-86. April 1974.

[18] National Security Industrial Association. Proceedings of Energy Conservation in Food Service Symposium, P. 24-25. March 1976.

[19] Shepherd, J. Energy-Saving Refrigeration Systems. Food Engineering. February 1977.

[20] Wiley, Judy. Energy Explodes as Industry's #1 Equipment Concern. Institution/Volume Feeding, 1 May 1977.

Points brought out by the above publications are often similar.

A condensed summary of essential recommendations is as follows:

1. Turn off equipment, lights, and water when not needed.

2. Do not preheat equipment longer than manufacturer's instructions require. Generally 10 to 15 minutes is adequate, except for some extra-large ovens and deep-fat fryers.

3. Stress proper upkeep and maintenance:

   a. Repair all leaks -- steam and water.

   b. Adjust all gas burners for a blue flame.

   c. Calibrate oven thermostats to assure correct cooking temperature and time.

   d. Clean all refrigeration and air-conditioning condensor coils.

   e. Keep freezer defroster in good repair to prevent icing.

   f. Keep freezer and cooler door gaskets in good repair.

   g. Replace slipping or worn belts on fans.

   h. Keep water heater coils free from lime accumulations.

4. Sound operation procedures.

   a. Load and unload ovens quickly to avoid unnecessary heat loss. Open oven doors only when necessary.

   b. Schedule baking or roasting so that oven capacity can be fully utilized.

   c. Thaw frozen foods in refrigerator.

   d. Use only the size of oven that is needed for the job.

   e. Clean fryers and filter oil at least once a day.

   f. Clean griddles frequently.

   g. Drain water heater every six months.

h. Use dishwashing machien for full loads only Do not run dishwashing machine for a small number of soiled dishes.

i. Stagger start-up times of equipment to avoid heavy electrical demand at one time.

j. Inspect all heating and cooling air ducts for cleanliness, proper insulation, and leaks.

k. Cover utensils for faster cooking.

l. Develop a schedule for equipment use. Equipment should be turned on at a specific time, turned to a specific temperature, and turned off at a designated time.

m. For indoor lighting, fluorescent bulbs are more energy efficient than incandescent bulbs with the same wattage. When possible, consideration should be given to changing over from incandescent to fluorescent lighting.

n. Train personnel in energy conservation.

B. Limiting Demand Loads

Utility customers are usually charged by peak demand loads. These are determined by the maximum rate of energy used during a certain time interval. There are manufacturers who make demand load control systems[21,22,23] that can actually limit the rate of energy consumption of certain equipment or lights by temporarily turning them on and off at certain prescheduled times of day or night, or in specific sequence. By shedding the costly power

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21 AVTEC Industries Inc. AVTEC Energy Conservation with the Black Box. 1975.

22 Honeywell Inc., Demand Load Control. S.K. 11-76.

23 Texas Instruments Inc., Meet the STIP Programmable Control System. Industrial Controls, 643-B.

demand peaks, electric bills can be cut as much as 30%.

There is one monitoring and control system in use by the Marine Corps at Camp Pendleton, California.[24] This system was installed primarily for manpower and maintenance area use. This system has also been used in energy management by securing heating plants and equipment such as boilers and circulating pumps. A study on consumption of fuel oil and propane in buildings controlled by the system showed nearly a 50% reduction in fuel consumption in FY 74 and FY 75 over FY 73 levels.

C. Chemical Washers and Electric Ignitors

There are tableware washers that use chemical sanitizers instead of 180°F water.[25] Using only one water system for wash and rinse, the chemical washer does not require the use of a water heater booster, thus saving energy.

The operation of a standing pilot light continuously in gas appliances consumes energy. Studies have been conducted in evaluating the benefit and cost of an electric ignitor to replace a standing pilot.[26] The installation of an electric

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[24] Civil Engineering Laboratory, Naval Construction Battalion Center. Energy Monitoring and Control Systems. Civil Engineering Laboratory Tech Data Dheet 76-12. September 1976.

[25] Champion Ind. Champion Chemical Washer Tech Data C.K.W.-IR-3.

[26] Macriss, R.A. and R.H. Elins, Standing Pilot Gas Consumption. ASHRAE Journal, P. 54-47. June 1976.

ignitor would increase the cost of a unit. Therefore, the cost and benefit of an electric ignitor would have to be carefully evaluated for each application.

D. A Restaurant Tests Energy-Saving Systems

The Sambo Restaurant in Colonie, NY, is the first restaurant to be intensively monitored for energy efficiency and cost savings.[27,28,29] It is a cooperative venture involving the Federal Energy Research and Development administration (now a part of the Department of Energy), the New York State Assembly, and Sambo's Restaurant, Inc. The restaurant's heating, ventilating, and air conditioning (HVAC), and food preparation operations have been designed to include a complete system of energy conservation and energy reclamation equipment. The data collection of this study is still continuing.

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27 Nation's Restaurant News. Sambo's Feds Cooperate on Energy Use Tests. Nation's Restaurant News, 11 October 1976.

28 New York State Environment. New Restaurant Tests Energy-Saving Systems. NYS Environment, P. 12, July 1976.

29 Schneider, M. Sambo's Pioneers Energy Research. Institution/ Volume Feeding, P. 42-45, August 1975.

IV. Military Installations Surveyed

A. Number of Installations and Dining Facilities

Replies were received from more than 85% of the installations to which the survey questionnaires were sent. The 111 respondents that completed the questionnaire are listed in Appendix B. For data purposes in this report, a Naval ship is counted as one installation. There is usually more than one dining facility in an installation. There are 720 dining facilities among the 111 military installations from different Services as shown in Table 1.

Table 1. RETURNS OF QUESTIONNAIRE SURVEY IN ENERGY CONSERVATION

	Installations	Dining Facilities	Personnel Served
Navy			
Land Installations	44	57	49,932
Ships	12	20	6,220
Army	32	561	204,765
Marine Corps	23	82	52,070
Total	111	720	312,987

The number of dining facilities in an installation differs greatly. For example, there are 561 dining facilities in the 32 Army installations surveyed, with an average of 17.5 dining

facilities per installation; whereas there are 57 dining facilities in the 44 Navy land installations surveyed, for an average of 1.3 dining facilities per installation. In the Marine Corps installations surveyed there are an average of 3.6 dining facilities per installation.

B. Number of Persons Served in One Dining Facility

Table 2 contains data on the number of persons served per day in one dining facility -- grouped into six categories as 1-300, 301-1000, 1001-2000, etc. -- under the heading "Number of Persons Served Daily in One Dining Facility." The number of dining facilities that serve the number of persons is entered into each category. From the mean calculated and listed in Table 2, it is obvious that the Navy land installations, in general, serve more persons per dining facility than the Marine Corps, and more than twice as many as the Army installations. Some Army dining facilities are still housed in relatively small temporary structures and therefore can accommodate only a smaller number of persons. An Army modernization program on dining facilities is currently underway.

Table 2. Number of Persons Served Daily in One Dining Facility

Data from 111 Military Installations with 720 Dining Facilities

No. of Persons Served in One Dining Facility	Number of Dining Facilities			
	Navy Installations		Army Installations	Marine Corps Installations
	Land	Ships		
1 - 300	21	9	330	27
301 - 1,000	20	9	117	39
1,001 - 2,000	13	0	21	9
2,001 - 3,000	0	0	1	0
3,001 - 5,000	3[a]	0	1[b]	2[c]
No value given	0	2	91	5
Total	57	20	561	82
No. of persons served per day in one dining facility. Mean	876	311	365	635
Median	701	302	213	400

NOTES: [a] U.S. Naval Academy at Annapolis, MD, serves 4,300 midshipmen a day in one dining facility. Naval Training Center at Orlando, FL, serves 3,800 recruits a day in one dining facility and 4,000 in another.

[b] U.S. Military Academy at West Point, NY, serves 4,417 cadets a day in one dining facility.

[c] U.S. Marine Corps Air Station at Cherry Point, NC, serves 4,942 persons a day in one dining facility, and the Marine Corps Recruit Depot at San Diego, CA, serves 5,000 persons a day in one dining facility.

V. Major Cooking Equipment: Ovens, Deep-Fat Fryers and Griddles

Ovens, deep-fat fryers, and griddles are regarded as major energy users in the kitchen. They are divided into two groups -- electric and gas -- depending on the type of energy source they use. The electric items are listed in Table 3 and the gas items in Table 4. They are further grouped into power rating categories and hours of operation. The mean and median of power ratings and hours of operation are listed at the bottom of each table.

Tables 3 and 4 include all the military installations surveyed. The data on each Service are listed separately in Appendix C. There are a total of seven tables in Appendix C -- two for the Navy land installations, one for Navy ships, two for Army installations, and two for Marine Corps installations. Anyone desiring data on a particular Service should refer to the appropriate table in Appendix C. The cooking equipment on board Navy ships is all electric and not gas; therefore there are no data on gas equipment for Navy ships in Appendix C.

Significant data which show up in Tables 3 and 4 are the means of hours of operation. The hours of operation of ovens are more than twice as long as hours of operation of either deep-fat fryers or griddles. This is true for both electric and gas cooking equipment. It is true in Navy land installations and Navy ships, as well as in Army and Marine Corps installations, that the average power ratings of electric ovens are higher than the

Table 3. MAJOR ELECTRIC COOKING EQUIPMENT -- POWER RATINGS AND HOURS OF USAGE

Data from 111 Military Installations with 720 Dining Facilities

Power Ratings kW	Number of Units			Hours in Operation	Number of Units		
	Ovens	Deep-Fat Fryers	Griddles		Ovens	Deep-Fat Fryers	Griddles
1-10	136	118	154	1-5	127	498	615
11-20	286	331	371	6-10	304	99	191
21-35	147	89	240	11-15	197	8	9
36-50	58	2	3	16-20	52	0	16
51-80	6	0	0	21-24	15	0	0
No value given	79	70	78	No value given	17	5	15
Total	712	610	846	Total	712	610	846
kW Mean	17.3	14.8	17.1	Hours Mean	9.5	3.7	4.6
kW Median	12.5	15.3	12.2	Hours Median	8.4	3.2	4.0

Table 4. MAJOR GAS COOKING EQUIPMENT -- POWER RATINGS AND HOURS OF USAGE

Data from 111 Military Installations with 720 Dining Facilities

Power Rating, Btu/hr.	Number of Units			Hours in Operation	Number of Units		
	Ovens	Deep-Fat Fryers	Griddles		Ovens	Deep-Fat Fryers	Griddles
1 - 50	1055	258	512	1 - 5	221	784	675
51 - 100	71	293	190	6 - 10	781	144	223
101 - 300	132	334	43	11 - 15	285	7	3
301 - 500	16	0	0	16 - 20	112	0	0
501 - 700	10	0	0	21 - 24	10	0	0
701 - 900	12	4*	0				
900 - Up	0	4*	0				
No value given	149	102	179	No value given	36	60	23
Total	1445	995	924	Total	1445	995	924
1000 Btu/hr Mean	72.1	85.6	45.1	Hours Mean	9.1	3.7	4.2
Median	43.1	60.3	40.3	Median	8.2	3.4	4.1

*These are conveyorized deep-fat fryers. There are four in the 901,000 Btu/hr and up category -- a 2,000,000 Btu/hr conveyorized deep-fat fryer is located at the US Military Academy, West Point, NY; a 1,750,000 Btu/hr at the Naval Station at San Diego, CA; a 1,750,000 Btu/hr at the Naval Air Station at North Island, San Diego, CA; and a 1,600,000 Btu/hr at the Naval Amphibious Base at Little Creek, Norfolk, VA.

average power ratings of deep-fat fryers or griddles. Gas ovens are rated below deep-fat fryers but far above griddles. The average high power rating of deep-fryers is due to the presence of a few large conveyorized deep-fat fryers (marked with asterisks in Table 4). There are more gas ovens than gas deep-fat fryers; therefore ovens as a group are considered to be the highest energy-consuming items when compared with other major cooking equipment. The above observations may of course not be true in commercial operations.

From careful examination of the data in Appendix C, it is evident that Navy and Marine Corps installations use more electric cooking equipment than gas; whereas, in the Army installations the opposite is true -- the gas cooking equipment far outnumbers the electric. This fact is brought out in Table 5, under Electric Equipment/Gas Equipment, where a comparison of numbers of electric cooking equipment against gas is shown. For example, under Navy land installations, there are listed 198 electric ovens against 84 gas ovens, with a ratio of 2.4 to 1; whereas, under the Army installations, there are listed 252 electric ovens against 1,285 gas ovens, with a ratio of 0.2 to 1. There are also wider differences in ratios under the columns of Deep-Fat Fryers and Griddles. The Navy ships have no gas cooking equipment, and therefore only quantities of electric cooking equipment are listed in Table 5.

Table 5. COMPARISONS OF ELECTRIC AND GAS COOKING EQUIPMENT

Data from 111 Military Installations with 720 Dining Facilities

Electric Equipment/Gas Equipment

Installations	Ovens Number of Units			Deep-Fat Fryers Number of Units			Griddles Number of Units		
	Electric	Gas	Ratio	Electric	Gas	Ratio	Electric	Gas	Ratio
Navy Land	198	84	2.4:1	195	11	17.7:1	202	2	101:1
Ships	91	0	--	41	0	--	32	2	--
Army	252	1285	0.2:1	233	899	0.3:1	419	869	0.5:1
Marine Corps	171	76	2.3:1	141	85	0.7:1	193	53	3.6:1

VI. Ranges

Table 6 lists power ratings and hours of operation of both electric and gas ranges in all the military installations surveyed. Data on ranges in each Service are separately listed in Appendix D. Navy land and Marine Corps installations have very few ranges compared to Army installations (Table 7). For example, under Navy land installations, there are listed a total of 33 electric and gas ranges in 57 dining facilities, with an average of 0.6 range per dining facility; whereas under Army installations there are listed a total of 1,528 electric and gas ranges in 561 dining facilities, with an average of 2.7 ranges per dining facility.

Also, there are significant differences in the number of electric ranges against the nubmer of gas ranges. In Table 7, it is shown that there 1.5 electric ranges per gas range in Navy land installations; whereas, there is only 0.2 electric range per gas range in Army installations. This further substantiates the fact that the Navy uses more electric than gas cooking equipment.

Table 6. ELECTRIC AND GAS RANGES -- POWER RATINGS AND HOURS OF USAGE

Data from 111 Military Installations with 720 Dining Facilities

Electric Range		Gas Range		Hours in Operation	Number of Units	
Power Rating, kW	Number of Units	Power Rating, 1000 Btu/hr.	Number of Units		Electric	Gas
1-10	22	1-10	4	1-5	85	409
11-20	30	11-30	608	6-10	148	659
21-30	197	31-50	387	11-15	25	121
31-40	1	51-100	77	16-20	5	59
41-50	0	101-200	50	21-24	8	3
No value given	32	No value given	177	No value given	11	52
Total	282	Total	1303	Total	282	1303
kW Mean	19.8	1000 Btu per hr Mean	33.5	Mean Hours	7.6	7.3
Median	21.8	Median	22.1	Median	6.1	6.9

Table 7. COMPARISONS OF ELECTRIC AND GAS RANGES

Data from 111 Military Installations with 720 Dining Facilities

Installations	Electric ranges/Gas ranges		
	Number of Units		Ratio
	Electric	Gas	
Navy Land	20	13	1.5:1
Navy Ships	10	0	---
Army	249	1279	0.2:1
Marine Corps	3	11	0.3:1

VII. Dishwashers and Exhaust Hoods

Table 8 lists the power ratings and hours of operation of dishwashers and exhaust hoods in all military installations surveyed. Data on dishwashers and exhaust hoods in each Service are listed separately in Appendix E. Some dishwashers have electric hot water boosters. The boosters are included in the kW ratings of the dishwashers thus contributing to their high power ratings. (They are annotated with "a" in Table 8.)

It should also be noticed that exhaust hoods have long hours of operation. On Navy ships, due to varying demands and operating conditions at sea, reportedly some exhaust fans are being operated 24 hours a day (see Appendix E, Table E-2). However, the average operating time of exhaust hoods is about 12 hours a day.

VIII. Refrigerators/Freezers, Air Conditioning, and Hot Water Supplies

Table 9 lists the data on refrigerators/freezers, air-conditioning, and hot water supplies. There are 3,761 refrigerator/freezer units in 720 dining facilities. This averages about 5.2 units per dining facility, and each unit is in operation 24 hours a day. Because power ratings on refrigerator/freezers are not readily available from the units, the information gathered from the

Table 8. DISHWASHERS AND EXHAUST HOODS - POWER RATINGS AND HOURS OF USAGE

Data from 111 Military Installations with 720 Dining Facilities

Dishwashers		Exhaust Hoods		Hours in Operation	Number of Units	
kW	Number of Units	kW	Number of Units		Dishwashers	Exhaust Hoods
1 - 10	195	.1 - 2.0	175	1 - 5	134	93
11 - 20	60	2.1 - 5.0	100	6 - 10	586	318
21 - 30	35	5.1 - 10.0	32	11 - 15	47	271
31 - 40	34[a]	10.1 - 25.0	17[b]	16 - 20	21	147
41 - up	9[a]	25.1 - 60.0	3[b]	21 - 24	1	91
No value given	478	No value given	647	No value given	22	55
Total	811	Total	974	Total	811	974
kW Mean	13.5		3.7	Hours in Operation Mean	7.7	12.1
Median	7.7		1.6	Median	6.4	11.9

NOTES: [a] Many of the dishwashers with high kW ratings are due to the use of electric hot water boosters.

[b] These are central exhaust systems consisting of a number of hoods and fans.

Table 9. REFRIGERATORS/FREEZERS, AIR CONDITIONING, AND HOT WATER SUPPLIES

Data from 111 Military Installations with 720 Dining Facilities

I. Refrigerators/Freezers

Number of Units	3,761 in 720 dining facilities
Hours of Operation	all units in use 24 hours

II. Air Conditioning

Yes	294 Dining facilities
No	366 Dining facilities
No information given	60 Dining facilities
Total	720 Dining facilities

III. Hot water supplied by hot water tank installed in the dining facilities

Yes	303 Dining facilities
*No	279 Dining facilities
No information given	138 Dining facilities
Total	720 Dining facilities

*Note: The hot water is supplied by central system at installation.

questionnaire survey is incomplete and fragmentary and therefore not included in this report.

There are 294 air-conditioned dining facilities against 366 dining facilities that are not air-conditioned. All dining facilities surveyed on board Navy ships were air-conditioned and in most cases central air-conditioning systems were used.

There are 303 dining facilities that are supplied with hot water by units in their own dining facilities and 279 dining facilities that are supplied with hot water from their central installation systems.

IX. Local Adaptive Efforts in Energy Conservation

As a result of energy shortages, some local effort in energy conservation is already in practice in some military installations. Table 10, Item III, shows specific energy conservation efforts currently in use in all the installations surveyed. The majority of these installations indicated they were turning off equipment, lights, and water when not needed. They also cited management involvement in conducting unannounced inspections and visits to see that energy conservation practices were being carried out. There were many other specific efforts to conserve energy mentioned in the survey, such as keeping refrigerator doors closed, posting signs to promote the conserving of energy, etc., as listed in Table 10, Item III. The efforts on energy conservation

Table 10. LOCAL ADAPTIVE EFFORTS IN ENERGY CONSERVATION CURRENTLY IN USE

Data from 111 Military Installations

	No. of Installations
I. Does local training program include energy conservation?	
Yes	86
No	23
No information given	2
II. Are energy conservation efforts being used locally?	
Yes	80
No	28
No information given	3
III. Specific energy conservation efforts in use:	
A. Equipment turned off when not needed	69
B. Lights turned off when not needed	37
C. Unannounced inspection	15
D. Needless running water turned off	13

	No. of Installations
III. Specific energy conservation efforts in use: (Cont.)	
E. Management and Personnel involvement	11
F. Refrigerators kept closed (doors opened a minimum number of times)	8
G. Signs posted to promote conservation of energy	6
H. Maintenance problems reported promptly	4
I. People trained in proper use of equipment and ways to conserve energy	4
J. Better coordination in food preparation	3
K. Loading docks washed with cold water	3
L. Small unit used when large unit not needed	3
M. Menus planned for more efficient use of equipment	2
N. "Warm-up" time minimized	2
O. Solar screens in all galley windows	1

in specific Services are listed separately in Appendix G.

In addition to completing the survey, the following installations have sent us their instructions, posters, and directives issued at local levels for energy conservation in dining facilities: Naval Air Station at Norfolk, Virginia; Fort Carson, Colorado; Fort Leavenworth, Kansas; Aberdeen Proving Ground, Maryland; Fort Leonard Wood, Missouri; and Fort Lewis, Washington. As an example, we are attaching Appendix H, "Dining Facilities Conservation Standards" from Fort Leavenworth, Kansas. In general, these Conservation Standards are well thought out and could be used as references in energy conservation training programs, as well as check lists in actual operations.

X. Equipment Consuming Unusually Large Amounts of Energy

A part of our energy survey was designed to obtain information on equipment that consumed unusually large amounts of energy due to negligence in maintenance and/or failure of equipment components. Table 11 shows that 26 out of 111 military installations surveyed indicate that they have problems because their equipment consumes an excessive amount of energy. Most of these problems stem from malfunctioning equipment, such as thermostats not being properly calibrated, doors not closing properly, spigots leaking, etc. Some of these problems are due to equipment that is simply

Table 11. REASONS FOR EQUIPMENT CONSUMING AN UNUSUALLY LARGE AMOUNT OF ENERGY

Data from 111 Military Installations

	No. of Installations
I. Is an unusually large amount of energy consumed?	
Yes	26
No	74
No information given	11
II. Specific reasons why equipment consumes an unusually large amount of energy:	
A. Thermostat controls do not work properly	7
B. Public Works Department (Facilities Engineer) slow to make necessary repairs	6
C. Due to old equipment	5
D. Dishwashing machine is malfunctioning	5
E. Freezer door seals poorly	3
F. Equipment not turned off when not in use	2
G. Ovens take too long to preheat	1

	No. of Installations
II. Specific reasons why equipment consumes an unusually large amount of energy: (Cont.)	
H. Oven doors do not close properly	1
I. Leaking spigots from water inlets	1
J. Equipment being used improperly	1
K. Windows opened with air conditioning on	1
L. Electric steam line is not an economical source of heat	1

too old, slow requests for repairs and slow response to these requests from the Public Works Department or Facilities Engineers The specific reasons why equipment consumes an unusually large amount of energy are listed separately for all the Services in Appendix I, Tables I-1 through I-4.

XI. Suggestions in Areas where Energy Savings Can be Achieved Best

Table 12 shows that 85 of 111 installations surveyed offered suggestions on how energy savings can be achieved best. The most frequently mentioned suggestions are as follows:

a. Use more energy efficient equipment.

b. Turn off unnecessary equipment and lights.

c. Provide training programs for food service personnel.

d. Improve upkeep and maintenance programs.

e. Stress close supervision by key personnel.

A good training program for food service personnel on energy conservation and close supervision by key personnel would go a long way in saving energy. The Dining Facilities Conservation Standards listed in Appendix H require the awareness and cooperation of the food service personnel. Close supervision by key personnel is necessary to insure that energy conservation procedures are being carried out.

Many other suggestions for saving energy are listed in Table 12, some of which are being implemented in some installations, and some of which may prove to be impractical or difficult to implement,

Table 12. SUGGESTIONS IN AREAS WHERE ENERGY SAVINGS CAN BE BEST ACHIEVED

Data from 111 Military Installations

	No. of Installations
I. Can you suggest an area where energy savings can be best achieved?	
Yes	85
No	5
No information given	21
II. Suggestions on energy savings:	
A. Use more energy efficient equipment	21
B. Turn off unnecessary equipment and lights	21
C. Good training program for food service personnel	21
D. Proper upkeep and increased scope of maintenance procedures	19
E. Close supervision by key personnel	14
F. Use consolidated mess hall	7
G. Use microwave equipment	5

	No. of Installations
II. Suggestions on energy savings: (Cont.)	
H. Review master menu and eliminate foods requiring long cooking time	5
I. Don't turn on equipment too early	4
J. Use stack ovens instead of revolving ovens	3
K. Use wall posters to promote energy conservation	3
L. Use prepackaged convenience foods	3
M. Stress proper procedures of cooking	3
N. Use photocells or timers to turn off lights	2
O. Coordinate the use of high energy consumption equipment	2
P. Do not overload equipment	1
Q. Use gas ovens instead of electric ovens	1
R. Install double-door entrances	1
S. Lower ceilings to increase efficiency of air-conditioning	1
T. Use canned foods instead of frozen	1

	No. of Installations
II. Suggestions on energy savings: (Cont.)	
U. Use gas grills instead of electric broilers	1
V. Buy baked goods in open markets	1
W. Have several spearate circuits for lights	1
X. Serve more cold meals	1
Y. Redesign ship's galley	1

such as "Serve more cold meals" or "Lower ceilings to increase efficiency of air-conditioning."

XII. Possibilities of Metering and Monitoring Energy Consumption in Dining Facilities

Metering energy consumption in dining facilities would offer an opportunity to measure how efficiently energy was being utilized. The advantages of having metering devices in each dining facility are many, such as:

a. Metering devices could provide energy requirement data for preparing and serving a meal on the basis of number of Btu required per man per meal. Using the same basis, the energy efficiencies of different dining facilities could be analyzed and compared, thus giving a food service operator an incentive to manage his energy consumption.

b. Also, using the same basis, the energy consumption for specific menus, operations, and capacities in each dining facility could be analyzed and compared.

c. Energy consumption data would keep an operator informed of his current energy expenditures. Corrective measures could be taken quickly if there was a large energy drain in a dining facility.

There should be separate metering devices installed in dining facilities for measuring electricity, natural gas, water, and steam consumption. Personnel should be trained to read meters and keep

records. None of the dining facilities in the 111 military installations surveyed have installed and monitored all the necessary metering devices. Some installations have submitted estimated energy consumption data which were not derived from actual meter readings. Only the Naval Station in San Diego, California, and the Naval Air Station at North Island, San Diego, California, have installed both gas and electric meters in their dining facilities. A few installations have installed either gas or electric meters; however, none have collected and analyzed energy consumption data.

Many of the installations surveyed have expressed willingness to participate in conducting tests on energy conservation measures. However, upon actual contact or visits, it was learned that physical difficulties had arisen in installing metering devices in some dining facilities because the utilities were shared by non-food related activities, such as barracks, offices, and recreational centers. It would be difficult or almost impossible without great expenditures to rewire and rearrange the piping to isolate the energy consumption of the dining facilities. However, there are some separate structures in recently-built dining facilities that offer opportunities for installing meters and monitoring energy usage.

XIII. Visits to Dining Facilities at Military Installations

Several visits were made to military dining facilities for the purpose of observing energy utilization. The following observations were made:

A. Ovens were set at idling temperatures -- not turned off -- when not in operation.

A visit was made to a Naval installation because our survey questionnaire indicated that its ovens were set at an idling temperature -- not turned off -- when not being used. Our visit verified that the ovens at this installation were not turned off but turned down to 160°F (71.1°C) when not in operation. There are three Despatch Revolving Tray Ovens in the kitchen -- one is a 50 kW oven and two are 40 kW ovens. The 50 kW oven is used 12 hours a day from 0200 to 1400 hours for baking, and is kept idling at a low temperature for 12 hours when not in operation. The reason given was that two hours are required for preheating and therefore keeping the oven at a low temperature was not wasting energy.

Another Naval installation indicated that one of its ovens was not turned off but held at 300°F (148.8°C) when not in operation. We have not visited this installation.

We have conducted tests in our laboratory on a Middleby-Marshall oven for the purpose of comparing the amount of energy used to hold the oven at an idling temperature and the amount of energy used to

preheat the oven. We also made an investigation to determine the cost of installing an electric timer as an alternative for not holding the oven at an idling temperature. This information is summarized in Table 13.

Table 13 indicates that it requires 26 minutes to preheat an oven to a normal baking temperature of 425°F (218.3°C), thus the cost of a timer could be recovered in 59 days for an oven idling at 160°F (71.7°C) and in 10 days for an oven idling at 300°F (148.8°C). Also, energy savings would be 47.7% for an oven idling at 160°F (71.7°C) and 84.0% for an oven idling at 300°F (148.8°C). The installation of a timer on an oven, in lieu of holding oven at idling temperature when not in use, saves not only energy and money but also reduces wear and tear on the equipment and therefore minimizes equipment breakdown. It is a mistaken belief that keeping an oven at idling temperature when not in use is good for the oven and food quality. A timer would insure the desired preheated temperature without subjecting the oven to holding temperatures for long periods of time. Continuous operation at high temperatures is the main cause for equipment breakdown. Even at idling temperatures the trays in revolving tray ovens are in continuous motion. This constant wear and tear eventually leads to early breakdown. Only when electricity is shut off will the revolving trays in the ovens cease to rotate.

Table 13. ENERGY REQUIRED FOR HOLDING AN OVEN AT IDLING TEMPERATURE VS INSTALLING ELECTRIC TIMER

	Oven Held at Idling Temperature When Not in Use	
	160°F (71.1°C)	300°F (148.8°C)
Energy required to hold 50 kW oven at idling temperature		
for 1 hour	5.5 kWh	18.0 kWh
for 12 hours	66.0 kWh	216.0 kWh
Energy required to preheat oven 26 minutes to 425°F	34.5 kWh	34.5 kWh
Extra energy required to hold oven at idling temperature (66.0 minus 34.5) (216.0 minus 34.5)	31.5 kWh	181.5 kWh
Extra energy required for oven idling (2.5¢ per kWh)	$0.788	$4.538

Installation of electric timer:

Cost of hand-set interval timer	=	$32.00
Installation labor (1 hour)	=	12.00
Total		$44.00

To pay back cost of timer:

For oven idling at 160°F (71.1°C) = $\frac{\$44.00}{0.788}$ = 59 days

For oven idling at 300°F (148.8°C) = $\frac{\$44.00}{4.538}$ = 10 days

% of energy savings:

For oven idling at 160°F (71.1°C) = $\frac{31.5}{66.0} \times 100 = 47.7\%$

For oven idling at 300°F (148.8°C) = $\frac{181.5}{216.0} \times 100 = 84.0\%$

NOTE: The drive motor for the timer is 5 watts maximum. The electric consumption is so low that it is not listed.

B. Equipment turned on too early for preheating.

A visit was made to an Army installation early in the morning at 0300 hours when the food personnel were starting to prepare breakfast for 0415 -0530 hours. All the equipment for preparing breakfast -- including two conveyor toasters that were not used until 1415 hours -- were turned on at 0300 hours.

Another observation made that afternoon was that a food warmer door was kept open when trays of food were in the cabinet to be kept warm.

The above observations are cited to exemplify that simple operations could be corrected which would not only save money and energy but reduce the likelihood of equipment breakdown. Also, there were energy conservation instructions and standards in effect that were not being enforced.

XIV. Achievable Energy Conservation and Cost Savings

From the energy data collected in this survey, the energy consumption of major food service equipment and its possible cost savings can be calculated. Table 14 shows the cost of electricity and Table 15 the cost of gas of the major food service equipment of 720 dining facilities serving 313,000 personnel covered in this survey. The amount of electricity consumed by ovens, fryers, griddles, ranges, dishwashers, and exhaust hoods

Table 14. ELECTRICITY COST OF MAJOR FOOD SERVICE EQUIPMENT IN 720 DINING FACILITIES SERVING 312,987 PERSONNEL

Equipment	Power Rating kW Mean	Total Units	Hours of Usage Per Day Mean	Total kWh
Ovens	17.3	712	9.5	117,017
Fryers	14.9	610	3.7	33,404
Griddles	17.1	846	4.6	66,546
Ranges	19.8	282	7.6	42,435
Dishwashers	13.5	811	7.7	84,303
Exhaust Hoods	3.7	974	12.1	43,606
Refrigerators & Freezers	1.2	3761	24.0	108,316
			Total	496 x 10^3 kWh/Day
			On Time, 70%	347 x 10^3 kWh/Day
				127 x 10^6 kWh/Year
				*$5,080,300/Year

*Electricity cost is based on 4¢ per kWh

Table 15. GAS COST OF MAJOR FOOD SERVICE EQUIPMENT

IN 720 DINING FACILITIES SERVING 312,987 PERSONNEL

Equipment	Power Rating 1000 Btu/hr Mean	Total Units	Hours of Usage Per Day Mean	Total 1000 Btu
Ovens	72.1	1445	9.1	948,079
Fryers	85.6	995	3.7	315,136
Griddles	45.1	924	4.2	175,024
Ranges	33.5	1303	7.3	318,649
			Total	1757×10^6 Btu/Day
			On Time, 70%,	1230×10^6 Btu/Day
				449×10^9 Btu/year
				449×10^6 ft^3/year
				*$1,347,000/year

*Gas price is based on $3 per 1000 cu ft natural gas.

was calculated from data listed in Tables 3, 6, and 8. The electricity consumption of refrigerators and freezers was obtained from estimates made during visits to dining facilities at Fort Lee, and the number of units was obtained from Table 9. The data used for calculations of gas consumption were derived from Tables 4 and 6. The power on time was estimated to be 70% of the equipment usage time.

The electricity and gas costs of major food service equipment for feeding 313,000 military personnel (Tables 14 and 15) and the cost of energy for feeding the current DOD military personnel of two million (quoted directly from military sources in World Almanac and Books of Facts, 1978)[30] can be proportionately calculated. For calculation purposes, if two-thirds of the total military personnel are fed in military dining facilities, Table 16 shows the different levels of energy conservation and the possible cost savings for feeding 1,380,000 personnel (two-thirds of two million). Please note that the cost savings cover only the energy used by major food service equipment. Energy used for generating steam, and energy used by smaller equipment, lighting, air-conditioning, sanitation, etc., have not been taken into account.

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[30] World Almanac and Book of Facts, 1978.

The steps recommended in the "Comments" in Table 16 for conserving 5% and 10% energy are those that do not require heavy capital investment. Most of the steps could be put into practice by management involvement in "common sense" approaches, such as not allowing equipment to be turned on too early, by turning off equipment and lights as soon as possible, keeping freezers and refrigerators closed, improving maintenance procedures, installing timers for turning power on and off on some selected equipment, etc. To achieve energy cost savings of 20 to 30%, some automatic controls and monitoring devices would be necessary, plus a change in cooking and feeding methods and systems.

Table 16. ACHIEVABLE ENERGY CONSERVATION AND COST SAVINGS

Electricity and Gas Expenditures of Major Equipment Per Year.

1. 313,000 military personnel (from survey) costs $6,427,000.
2. 2,072,200 DOD military personnel (1977) costs $42,546,700.
3. For calculation purposes, the following is based on the assumption if two-thirds of DOD military personnel are fed in dining facilities at a cost of $28,364,500.

Level of Energy Conservation	Cost Savings/ Year, Millions	
5%	1.4	1. Personnel training, management involvement (limit preheat time, turn off equipment as soon as possible, keep refrigerators and freezers closed, etc.)
10%	2.8	2. In addition to Comment 1, install timers for turning equipment on and off, improve maintenance procedure, use energy efficient equipment, etc.
20%	5.7	3. In addition to Comment 1, & 2, shift peak demand loads, better design & insulation, better specifications, etc.
30%	8.5	4. In addition to Comment 1, 2, & 3, recovery of waste energy, efficient cooking methods, consolidated feeding, etc.

XV. Recommendations

1. Based on survey data, literature review, visits and observations, it is recommended that the Food Service Headquarters Office of each Service issue a directive to its respective installations requesting that the following actions be taken:

a. That electric interval timers be installed in ovens that are normally heated and allowed to idle overnight when not in use. It is a common practice in bake shops to allow ovens to idle overnight. This practice not only wastes energy but leads to frequent equipment breakdowns. With the installation of timers, the ovens could be turned on automatically for preheating. The cost of installing a timer is about $44.00 which could be recovered in energy savings in a matter of days (See Table 13). To eliminate overnight idling, but to start the oven with a timer for preheating, the energy savings from an oven idling at 160°F (71.1°C) is 47.1% and that from an oven idling at 300°F (148.8°C) is 84.0%. Our laboratory tests show that, when the temperature control is set, it requires only 26 minutes to preheat a Middleby-Marshall oven to a baking temperature of 425°F (218.3°C). We have checked this preheating time of 26 minutes with the oven manufacturer.

b. That consideration be given to the installation of electric timers to turn off exhaust hoods that do not have

automatic shut-offs. Our survey indicates that exhaust hoods are being operated for long periods of time -- sometimes overnight. In general, exhaust hoods should be turned off by timers no later than two hours after the kitchen work has been completed.

c. That, with the exception of large equipment such as bakery ovens and continuous conveyorized deep-fat fryers, it be made mandatory that equipment not be turned on more than 15 minutes prior to actual usage. It has been observed that equipment is being turned on too early, especially in the mornings.

d. That energy conservation be included in the training of food service personnel and in briefings given to new dining-facility employees. Appendix H, Dining Facilities Conservation Standards, could be used as a reference for this training.

e. That close supervision by management and supervisors be emphasized. Many installations have issued local energy conservation regulations and directives, but have infrequently enforced them. It was noted from survey data and actual observations that some food warmer cabinets were left open, leaks in steam lines and water spigots were not repaired, the seals on freezer doors were in poor condition, windows were open when air-conditioning was on, and that the local Public Works Department was slow in making necessary repairs. (These are some of the things that require close supervision and follow-up.)

The preceding low cost and/or no-cost conservation measures not only can save energy, but will also greatly reduce equipment breakdowns as a result of not unnecessarily holding equipment at idling temperatures.

2. The installation of meters should be incorporated in the building program of new dining facilities, since energy metering is one of the most important aspects of the conservation program. It is much less costly to put meters in as part of the building requirement. Meters should be installed to measure electricity, gas, steam, and water usage.

3. Further studies should be made in specifying operating procedures, equipment utilization, menu selection, and optimum feeding capacity so that maximum potential energy conservation could be realized.

4. Ovens as a group have been identified as the largest energy user; ovens and exhaust hoods have the longest operation hours. Other large energy users, such as warewashers, griddles, deep-fat fryers, etc., should also be evaluated to identify such as special designs and/or insulation properties that might affect their energy consumption. An energy efficient measurement center is being set up at NARADCOM especially for such analytical purposes.

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APPENDIX A

QUESTIONNAIRE ON ENERGY CONSERVATION IN MILITARY FOOD SERVICE FACILITIES

Part A - Equipment in Kitchen/Mess Hall

1. Name of Installation: _____

   Kitchen/Mess Hall No: _____

   Size of Kitchen -
   No. of individuals served: _____

2. Does Kitchen/Mess Hall have separate electric and/or gas meters:

   a. Separate electric meter: Yes _____, No _____

   b. Separate gas meter: Yes _____, No _____

   If it is possible, please find out how much energy is consumed in the Kitchen/Mess Hall each month.

   a. Electricity (Kilowatt hours per month): _____

   b. Natural gas (thousand cu. ft. per month): _____

   c. Fuel oil (gallons per month): _____

   d. Hot water (gallons per month) _____

3. Enter equipment data as follows:

   a. Electric Ovens

      How many: _____

      Manufacturer: _____ _____ _____ _____

      Power rating, kW: _____ _____ _____ _____

      Average hours in operation per day:

      _____ _____ _____ _____

Part A - Equipment in Kitchen/Mess Hall (Cont.)

b. Gas Ovens

How many: _____

Manufacturer: _____ _____ _____ _____

Power rating, Btu per hour:

_____ _____ _____ _____

Average hours in operation per day:

_____ _____ _____ _____

c. Freezers/Refrigerators

How many: _____

Manufacturer: _____ _____ _____ _____

Power rating, kW: _____ _____ _____ _____

Average hours in operation per day:

_____ _____ _____ _____

d. Fryers

How many: _____

Manufacturer: _____ _____ _____ _____

Power rating, kW: _____ _____ _____ _____

Average hours in operation per day:

_____ _____ _____ _____

e. Grills

How many: _____

Manufacturer: _____ _____ _____ _____

Power rating, kW, or Btu per hour:

_____ _____ _____ _____

Average hours in operation per day:

_____ _____ _____ _____

Part A - Equipment in Kitchen/Mess Hall (Cont.)

f. Dishwashers

How many: _____

Manufacturer: _____ _____ _____ _____

Power rating, kW or Btu/hr: _____ _____ _____ _____

Average hours in operation per day:

_____ _____ _____ _____

g. Electric Ranges

How many: _____

Manufacturer: _____ _____ _____ _____

Power rating, kw: _____ _____ _____ _____

Average hours in operation per day:

_____ _____ _____ _____

h. Gas Ranges

How many: _____

Manufacturer: _____ _____ _____ _____

Btu rating/hr: _____ _____ _____ _____

Average hours in operation per day:

_____ _____ _____ _____

i. Other high-energy consumption equipment not listed above.

_____

_____

Part A - Equipment in Kitchen/Mess Hall (Cont.)

4. Is the mess hall air-conditioned: Yes _____, No _____

   If "Yes," specify size of air-conditioning unit: Tons _____

5. Hot Water

   a. Supplied by the Installation boiler room: Yes _____, No_____

   b. Separate hot-water heater in food service facility:

      Yes _____, No_____

      If "Yes," specify size of separate hot-water heater:

      Gallons of water_____

6. Is there an exhaust hood in the cooking area?

   Manufacturer: _____ _____ _____ _____

   Power rating, kW:_____ _____ _____ _____

   Average hours in operation per day:

   _____ _____ _____ _____

QUESTIONNAIRE ON ENERGY CONSERVATION MILITARY
FOOD SERVICE FACILITIES

Part B - Suggestions and Comments

1. Does your personnel training program include energy conservation?

   Yes _____, No_____

   If "Yes," please elaborate: _____

   _____

   _____

2. Is an energy monitoring or energy conservation measure being practiced in your food service?

   Yes _____, No _____

   If "Yes," please elaborate: _____

   _____

   _____

3. Can you cite examples of equipment that consume a large amount of energy due to negligence in maintenance or failure of equipment components: _____

   _____

   _____

4. As a research project on energy consumption, would there be any difficulty in installing an electric meter and/or gas meter in your food service facilities to monitor energy consumption?

   Please comment: _____

   _____

   _____

Part B - Suggestions and Comments (Cont.)

5. Please suggest in what area and in what way energy savings can best be achieved in Military food service. _____

_____

_____

_____

_____

6. Would you be willing to participate in conducting tests on energy conservation measures?

Yes _____, No _____

Comments: _____

_____

_____

7. Other comments and/or suggestions: _____

_____

_____

_____

Contributor _____

Rank and position _____

Installation _____

Address _____

_____

Telephone Number

Autovon _____

Commercial _____

Date _____

APPENDIX B

NAMES OF INSTALLATIONS AND THEIR DINING FACILITIES SURVEYED

I. Navy	Number of Dining Facilities
A. Ashore Activities	
Naval Air Stations	
1. Cecil Field, FL	2
2. Key West, FL	2
3. Norfolk, VA	1
4. Oceana, Virginia Beach, VA	1
5. Alameda, CA	1
6. Lemoore, CA	3
7. Miramar, San Diego, CA	1
8. Moffett Field, CA	1
9. North Island, San Diego, CA	3
10. Whidbey Island, Oak Harbor, WA	2
11. Fallon, NV	1
12. Lakehurst, NJ	1
13. Atlanta, Marietta, GA	1
14. Dallas, TX	1
15. New Orleans, LA	1
16. Willow Grove, PA	1
17. Los Alamitos, CA	1

Naval Air Stations (Cont.)

		Number of Dining Facilities
18.	Meridian, MS	2
19.	Whiting Field, Milton, FL	1
20.	Memphis, Millington, TN	1
21.	Pensacola, FL	2
22.	Chase Field, Beeville, TX	1
23.	Kingsville, TX	1
24.	Corpus Christi, TX	1
25.	Brunswick, ME	1

Naval Stations

26.	Charleston, SC	1
27.	Mayport, FL	1
28.	Norfolk, VA	1
29.	San Diego,CA	3

Naval Facilities

30.	Cape Hatteras, Buxton, NC	1
31.	Lewes, DE	1
32.	Point Sur, Big Sur, CA	1
33.	Centerville Beach, Ferndale, CA	1
34.	Pacific Beach, WA	1
35.	Coos Head, Coos Bay, OR	1

		Number of Dining Facilities
Amphibious Bases		
36.	Little Creek, VA	2
37.	Coronado, San Diego, CA	2
Shipyards		
38.	Portsmouth, VA	1
39.	Bremerton, WA	1
40.	Training center - Orlando, FL	2
41.	Submarine Base - New London, CT	1
42.	Support Activity - Los Angeles, Long Beach, CA	1
43.	Naval Weapons Station, Colts Neck, NJ	1
44.	U.S. Naval Academy, Annapolis, MD	1

Total of 44 Naval Land Installations - with 57 Dining Facilities

B. Naval Ships

	Number of Dining Facilities
1. 29MBD - USS Sprunace (DD-963)	1
2. 29R4K - USS Miller (FF-1091)	2
3. 29E3A - USS California (CGN-36)	4
4. 29E2M - USS Biddle (CG-34)	2
5. 29E2F - USS Richmond K. Turner (CG-20)	1
6. 290C - USS Richard E. Byrd (DDG-23)	1
7. 290S- USS Koontz (DDG-40)	1
8. 32AC- USS Puget Sound (AD-38)	4
9. 32CB - USS Mount Baker (AE-34)	1
10. 31CG- USS Nashville (LPD-13)	1
11. 32HA - USS Detroit (AOE-4)	1
12. 31MJ - USS Spartanburg County (LST-1192)	1

Total of 12 Naval Ships -
with 20 Dining Facilities

II. Army	Number of Dining Facilities
1. U.S. Military Academy West Point, NY	10
2. Fort Belvoir, VA	5
3. Fort Dix, NJ	18
4. Fort Knox, KY	50
5. Fort George G. Meade, MD	7
6. Fort Benning, GA	48
7. Fort Bragg, NC	55
8. Fort Campbell, KY	39
9. Fort Jackson, SC	43
10. Fort McClellan, AL	3
11. Fort Stewart, GA	10
12. Fort Bliss, TX	24
13. Fort Hood, TX	32
14. Fort Sam Houston, TX	3
15. Fort Sill, OK	34
16. Fort Carson, CO	18
17. Fort Leavenworth, KS	5
18. Fort Ord, CA	40
19. Fort Monmouth, NJ	2
20. Redstone Arsenal, AL	3
21. Aberdeen Proving Ground, MD	6

		Number of Dining Facilities
22.	White Sands Missile Range, NM	1
23.	Walter Reed Army Medical Center Washington, DC	2
24.	Fort Lee, VA	8
25.	Fort Gordon, GA	20
26.	Fort Leonard Wood, MO	19
27.	Fort Polk, LA	13
28.	Fort Sheridan, IL	2
29.	Fort McPherson, GA	1
30.	Fort Rucker, AL	3
31.	Fort Lewis, WA	36
32.	Fort Benjamin Harrison, IN	1

Total of 32 Army Installations - with 561 Dining Facilities

III. Marine Corps		Number of Dining Facilities
1.	Marine Corps Logistics Support Base, Atlantic - Albany, GA	4
2.	Marine Corps Logistics Support Base, Pacific - Barstow, CA	1
3.	Marine Corps Air Station Beaufort, SC	1
4.	Marine Corps Base Camp Lejeune, NC	17
5.	Marine Corps Base Camp Pendleton, CA	21
6.	Marine Barracks Charleston, SC	1
7.	Marine Corps Air Station Cherry Point, NC	1
8.	Marine Barracks Concord, CA	1
9.	Marine Barracks Colts Neck, NJ	1
10.	Marine Corps Air Station El Toro, CA	3
11.	Marine Barracks Hawthorne, NV	1
12.	Marine Barracks McAlester, OK	1
13.	Marine Barracks Newport, R.I.	1
14.	Marine Barracks Norfolk, VA	1

III. Marine Corps (Cont.)	Number of Dining Facilities
15. Marine Corps Recruit Depot Parris Island, SC	7
16. Marine Barracks Portsmouth, NH	1
17. Marine Corps Recruit Depot San Deigo, CA	4
18. Marine Corps Base Twentynine Palms, CA	3
19. Marine Barracks Vallejo, CA	1
20. Headquarters Battalion Arlington, VA	1
21. Marine Barracks Washington, DC	1
22. Marine Corps Air Station Yuma, AZ	1
23. Marine Corps Development and Education Command, Quantico, VA	8
Total of 23 Marine Corps Installations - with 82 Dining Facilities	

APPENDIX C

Table C-1. MAJOR ELECTRIC COOKING EQUIPMENT -- POWER RATING, AND HOURS IN OPERATION

Navy Land Installations Surveyed

Power Rating, kW	Number of Units			Hours in Operation	Number of Units		
	Ovens	Deep-Fat Fryers	Griddles		Ovens	Deep-Fat Fryers	Griddles
1-10	52	21	20	1-5	33	147	118
11-20	89	87	42	6-10	78	40	73
21-35	20	56	101	11-15	75	0	2
36-50	21	0	0	16-20	2	6	7
51-80	1	0	0	21-24	4	0	0
No value given	15	31	39	No value given	6	2	2
Total	198	195	202	Total	198	195	202
kW Mean	15.8	16.8	24.0	Hours Mean	9.4	4.2	5.9
Median	11.2	18.0	31.6	Median	8.4	3.1	5.2

APPENDIX C

Table C-2. MAJOR GAS COOKING EQUIPMENT -- POWER RATING AND HOURS IN OPERATION

Navy Land Installations Surveyed

Power Rating, 1000 Btu/hr.	Number of Units			Hours in Operation	Number of Units		
	Ovens	Deep-Fat Fryers	Griddles		Ovens	Deep-Fat Fryers	Griddles
1-50	0	0	2	1-5	6	7	2
51-100	4	0	0	6-10	26	4	0
101-300	24	4	0	11-15	15	0	0
301-500	13	0	0	16-20	23	0	0
501-700	4	0	0	21-24	3	0	0
701-900	12	4*	0				
901 Up	0	3*	0				
No value given	27	0	0	No value given	11	0	0
Total	84	11	2	Total	84	11	2
1000 Btu/hr Mean	376	799	14	Hours Mean	12.6	4.2	4.0
1000 Btu/hr Median	328	800	14	Hours Median	13.7	5.0	4.0

* These are conveyerized deep-fat fryers. Two of the three fryers listed as 900,000 Btu and up are rated as having 1,750,000 Btu maximum input; and one is rated as having 1,600,000 Btu maximum input.

APPENDIX C

Table C-3. MAJOR ELECTRIC COOKING EQUIPMENT -- POWER RATING AND HOURS IN OPERATION

Navy Ships Surveyed

Power Rating, kW	Number of Units			Hours of Usage	Number of Units		
	Ovens	Deep-Fat Fryers	Griddles		Ovens	Deep-Fat Fryers	Griddles
1-10	0	8	3	1-5	13	39	18
11-20	37	29	22	6-10	20	2	7
21-35	48	1	1	11-15	36	0	0
36-50	0	0	0	16-20	14	0	4
51-80	0	0	0	21-24	8	0	0
No value given	6	3	6	No value given	0	0	3
Total	91	41	32	Total	91	41	32
kW Mean	21.2	16.2	18.1	Hours Mean	12.7	2.9	6.2
Median	23.5	17.9	18.8	Median	12.1	2.7	4.3

APPENDIX C

Table C-4. MAJOR ELECTRIC COOKING EQUIPMENT -- POWER RATING AND HOURS IN OPERATION

Army Installation Surveyed

Power Rating, kW	Number of Units			Hours of Operation	Number of Units		
	Ovens	Deep-Fat Fryers	Griddles		Ovens	Deep-Fat Fryers	Griddles
1-10	31	72	103	1-5	43	201	324
11-20	106	127	272	6-10	121	31	78
21-35	62	5	13	11-15	55	0	5
36-50	0	0	0	16-20	23	0	5
51-80	0	0	0	21-24	0	0	0
No value given	53	29	31	No value given	10	1	7
Total	252	233	419	Total	252	233	419
kW Mean	15.3	12.0	11.2	Hours Mean	8.8	3.5	3.9
Median	12.8	11.9	11.8	Median	8.0	3.5	3.4

APPENDIX C

Table C-5. MAJOR GAS COOKING EQUIPMENT -- POWER RATING AND HOURS OF USAGE

Army Installations Surveyed

Power Rating, 1000 Btu/hr.	Number of Units			Hours in Operation	Number of Units		
	Ovens	Deep-Fat Fryers	Griddles		Ovens	Deep-Fat Fryers	Griddles
1-50	1042	246	477	1-5	206	712	639
51-100	59	290	190	6-10	720	125	209
101-300	63	260	26	11-15	251	7	3
301-500	0	0	0	16-20	78	0	0
501-700	6	0	0	21-24	5	0	0
701-900	0	0	0				
901 Up	0	1*	0				
No value given	115	102	176	No value given	25	55	18
Total	1285	899	869	Total	1285	899	869
1000 Btu/hr Mean	53.3	72.3	45.0	Hours Mean	8.8	3.7	4.2
1000 Btu/hr Median	42.0	60.2	40.4	Hours Median	8.1	3.4	4.0

* US Military Academy at West Point, N.Y., has a 2,000,000 Btu/hr conveyor fryer. It is used only when the small gas fryers are inoperative.

APPENDIX C

Table C-6. MAJOR ELECTRIC COOKING EQUIPMENT -- POWER RATING AND HOURS IN OPERATION

Marine Corps Installation Surveyed

Power Rating, kW	Number of Units			Hours in Operation	Number of Units		
	Ovens	Deep-Fat Fryers	Griddles		Ovens	Deep-Fat Fryers	Griddles
1-10	53	17	28	1-5	38	111	155
11-20	54	88	35	6-10	85	26	33
21-35	17	27	125	11-15	31	0	2
36-50	37	2	3	16-20	13	2	0
51-80	5	7	2	21-24	0	0	0
No value given	5	7	2	No value given	1	2	3
Total	171	141	193	Total	173	141	193
kW Mean	19.5	16.5	23.0	Hours Mean	9.0	3.5	4.3
Median	12.2	17.8	22.1	Median	8.1	3.0	4.1

APPENDIX C

Table C-7. MAJOR GAS COOKING EQUIPMENT -- POWER RATING AND HOURS IN OPERATION

Marine Corps Installations Surveyed

Power Rating, kW	Number of Units			Hours in Operation	Number of Units		
	Ovens	Deep-Fat Fryers	Griddles		Ovens	Deep-Fat Fryers	Griddles
1- 50	13	12	35	1-5	9	65	34
51-100	8	3	0	6-10	35	15	14
101-300	45	70	27	11-15	19	0	0
301-500	3	0	0	16-20	11	0	0
501-700	0	0	0	21-24	2	0	0
701-900	0	0	0				
901 - Up	0	0	0				
No value given	7	0	3	No value given	0	5	5
Total	76	85	53	Total	76	85	53
1000 Btu/hr Mean	138.8	117.8	60.2	Hours Mean	10.7	3.8	4.4
1000 Btu/hr Median	120.4	127.3	36.4	Hours Median	10.2	3.5	4.7

APPENDIX D

Table D-1. ELECTRIC AND GAS RANGE -- POWER RATING AND HOURS IN OPERATION

Navy Land Installations Surveyed

Electric Power Rating, kW	Number of Units	Gas Power Rating 1000 Btu/hr.	Number of Units	Hours in Operation	Number of Units	
					Electric	Gas
1-10	9	1-10	0	1-5	15	1
11-20	7	11-30	1	6-10	1	12
21-30	0	31-50	0	11-15	0	0
31-40	0	51-100	0	16-20	0	0
41-50	0	101-200	0	21-24	4	0
No value given	4	No value given	12	No value given	0	0
Total	20	Total	13	Total	20	13
kW Mean	9.5	1000 Btu/hr Mean	30	Hours Mean	8.4	7.5
Median	7.3	Median	30	Median	4.9	7.6

APPENDIX D

Table D-2. ELECTRIC RANGE -- POWER RATING AND HOURS IN OPERATION

Navy Ships Surveyed

Electric Power Rating, kW	Number of Units	Hours in Operation	Number of Units
1-10	2	1-5	2
11-20	0	6-10	3
21-30	3	11-15	2
31-40	0	16-20	0
41-50	0	21-24	0
No value given	3	No value given	3
Total	10	Total	10
kW Mean	19.4	Hours in Operation Mean	7.0
kW Median	20.8	Hours in Operation Median	7.8

APPENDIX D

Table D-3. ELECTRIC AND GAS RANGES -- POWER RATINGS AND HOURS IN OPERATION

Army Installations Surveyed

Electric Power Ratings, kW	Number of Units	Gas Power Rating 1000 Btu/hr.	Number of Units	Hours in Operation	Number of Units	
					Electric	Gas
1-10	11	1-10	4	1-5	65	400
11-20	20	11-30	605	6-10	144	645
21-30	192	31-50	384	11-15	23	121
31-40	1	51-100	77	16-20	5	59
41-50	0	101 Up	50	21-24	4	3
No value given	25	No value given	159	No value given	8	51
Total	249	Total	1279	Total	249	1279
kW Mean	20.7	1000 Btu/hr Mean	33.5	Hours Mean	7.2	7.3
Median	21.8	Median	22.0	Median	6.2	6.9

APPENDIX D

Table D-4. ELECTRIC AND GAS RANGES -- POWER RATINGS AND HOURS IN OPERATION

Marine Corps Installations Surveyed

Electric Power Rating, kW	Number of Units	Gas Power Rating 1000 Btu/hr	Number of Units	Hours in Operation	Number of Units	
					Electric	Gas
1-10	0	1-10	0	1-5	3	8
11-20	3	11-30	2	6-10	0	2
21-30	0	31-50	3	11-15	0	8
31-40	0	51-100	0	16-20	0	0
41-50	0	101 Up	0	21-24	0	0
No value given	0	No value given	6	No value given	0	1
Total	3	Total	11	Total	3	11
kW Mean	14.0	1000 Btu/hr Mean	29.2	Hours Mean	4.0	3.7
kW Median	14.3	1000 Btu/hr Median	37.5	Hours Median	4.0	3.8

APPENDIX E

Table E-1. DISHWASHER AND EXHAUST HOODS -- POWER RATING AND HOURS IN OPERATION

Navy Land Installations

Dishwashers kW	Number of Units	Exhaust Hoods, kW	Number of Units	Hours in Operation	Number of Units	
					Dishwashers	Exhaust Hoods
1-10	50	.1-2.0	86	1-5	16	28
11-20	14	2.1-5.0	13	6-10	63	26
21-30	2	5.1-10.0	10	11-15	13	34
31-40	7[a]	10.1-25.0	3[b]	16-20	12	13
41 Up	1[b]	25.1-60.0	1[b]	21-24	0	37
No value given	32	No value given	36	No value given	2	11
Total	106	Total	149	Total	106	149
kW Mean	11.9		2.8	Hours Mean	8.6	13.6
Median	6.4		1.0	Median	7.7	13.7

NOTES: [a] High kW ratings are due to the use of electric not water boosters.

[b] These are central exhaust systems consisting of a number of hoods and fans.

APPENDIX E

Table E-2. DISHWASHER AND EXHAUST HOODS -- POWER RATINGS AND HOURS IN OPERATION

Navy Ships Surveyed

Dishwasher kW	Number of Units	Exhuast Hoods, kW	Number of Units	Hours in Operation	Number of Units	
					Dishwashers	Exhaust Hoods
1-10	9	0.1-2.0	4	1-5	7	2
11-20	0	2.1-5.0	1	6-10	17	10
21-30	3	5.1-10.0	4	11-15	0	1
31-40	0	10.1-25.0	0	16-20	2	1
41 Up	0	25.1-60.0	21	21-24	0	16
No value given	14	No value given	21	No value given	0	0
Total	26	Total	30	Total	26	30
kW Mean	9.8		3.1	Hours Mean	6.8	16.9
Median	7.5		5.0	Median	6.5	23.6

APPENDIX E

Table E-3. DISHWASHERS AND EXHAUST HOODS -- POWER RATINGS AND HOURS IN OPERATION

Army Installations Surveyed

Dishwashers kW	Number of Units	Exhaust Hoods, kW	Number of Units	Hours in Operation	Number of Units	
					Dishwashers	Exhaust Hoods
1-10	69	0.1-2.0	27	1-5	98	45
11-20	35	2.1-5.0	16	6-10	423	215
21-30	28	5.1-10.0	18	11-15	18	184
31-40	6[a]	10.1-25.0	12[b]	16-20	7	114
41 Up	7[a]	25.1-60.0	2[b]	21-24	1	16
No value given	421	No value given	536	No value given	19	37
Total	566	Total	611	Total	566	611
kW Mean	14.8		6.6	Hours Mean	7.1	11.6
Median	10.9		3.4	Median	6.3	11.7

NOTES: [a] High kW ratings are due to the use of electric hot water boosters.

[b] Many of the exhaust hoods are central system consisting of a number of hoods and fans.

APPENDIX E

Table E-4. DISHWASHERS AND EXHAUST HOODS -- POWER RATINGS AND HOURS IN OPERATION

Marine Corps Installations

Dishwashers kW	Number of Units	Exhaust Hoods, kW	Number of Units	Hours in Operation	Number of Units	
					Dishwashers	Exhaust Hoods
1-10	68	0.1-2.0	58	1-5	13	17
11-20	11	2.1-5.0	70	6-10	83	67
21-30	2	5.1-10.0	0	11-15	16	52
31-40	21	10.1-25.0	2	16-20	0	19
41 Up	0	25.1-60.0	0	21-24	0	22
No value given	11	No value given	54	No value given	1	7
Total	113	Total	184	Total	113	184
kW Mean	13.2		2.8	Hours Mean	7.8	11.8
Median	5.5		2.2	Median	7.5	11.7

APPENDIX F

Table F-1. REFRIGERATORS/FREEZERS, AIR-CONDITIONING, AND HOT WATER SUPPLIES

Navy Land Installations Surveyed

I. Refrigerators/Freezers	
Number of Units	All units in 57 dining facilities
Hours of operation	All units operated 24 hours
II. Air-Conditioning	
Yes	31 Dining facilities
No	25 Dining facilities
No information given	1 Dining facility
Total	57 Dining facilities
III. Hot water supplied by hot water heater in the dining facility.	
Yes	23 Dining facilities
*No	30 Dining facilities

III. Hot water supplied by hot water heater in the dining facility.(Cont.)

No information given	4 Dining facilities
Total	57 Dining facilities

*NOTE: The hot water is supplied from the installation central system.

APPENDIX F

Table F-2. REFRIGERATORS/FREEZERS, AIR-CONDITIONING, AND HOT WATER SUPPLIES

Navy Ships Surveyed

I. Refrigerators/Freezers	
Number of Units	64 units in 20 dining facilities
Hours of operation	All units in use 24 hours
II. Air-Conditioning	
Yes	All are air-conditioned
III. Hot water supplied by hot water heater in the dining facility	
Yes	8 Dining facilities
*No	11 Dining facilities
No information given	1 Dining facility
Total	20 Dining facilities

*NOTE: The hot water is supplied from the installation central system.

APPENDIX F

Table F-3. REFRIGERATORS/FREEZERS, AIR-CONDITIONING, AND HOT WATER SUPPLIES

Army Installations Surveyed

I.	**Refrigerators/Freezers**	
	Number of Units	2,829 units in 561 Dining facilities
	Hours of operation	All units operated 24 hours
II.	**Air-Conditioning**	
	Yes	215 Dining facilities
	No	290 Dining facilities
	No information given	56 Dining facilities
	Total	561 Dining facilities
III.	**Hot water supplied by hot water heater at the dining facility**	
	Yes	260 Dining facilities
	*No	195 Dining facilities

III. Hot water supplied by hot water heater at the dining facility. (Cont.)

No information given	106 Dining facilities
Total	561 Dining facilities

*NOTE: The hot water is supplied from the installation central system.

APPENDIX F

Table F-4. REFRIGERATORS/FREEZERS, AIR-CONDITIONING, AND HOT WATER SUPPLIES

Marine Corps Installations Surveyed

I. Refrigerators/Freezers	
Number of Units	437 units in 82 Dining facilities
Hours of operation	All units operated 24 hours
II. Air-Conditioning	
Yes	28 Dining facilities
No	51 Dining facilities
No information given	3 Dining facilities
Total	82 Dining facilities
III. Hot water supplied by hot water heater at the dining facility.	
Yes	12 Dining facilities
*No	43 Dining facilities

III. Hot water supplied by hot water heater at the dining facility.(Cont.)

No information given	27 Dining facilities
Total	82 Dining facilities

*NOTE: The hot water is supplied from the installation central system.

APPENDIX G

Table G-1. LOCAL ADAPTIVE EFFORTS ON ENERGY CONSERVATION CURRENTLY IN USE

Navy Land Installations Surveyed

	No. of Installations
I. Does local training program include energy conservation?	
Yes	37
No	7
II. Are energy conservation efforts being used locally?	
Yes	33
No	11
III. Specific energy conservation efforts currently being used:	
A. Turn off equipment when not needed	26
B. Turn off lights when not needed	20

	No. of Installations
III. Specific energy conservation efforts currently being used: (Cont.)	
C. Signs are posted to promote energy conservation	5
D. Turn off needless running water	3
E. Keep refrigerators closed (doors are opened a minimum number of times)	3
F. Better coordination in food preparation	3
G. Management and Personnel Involvement	1
H. Use small unit when large unit is not needed	1
I. Menus are planned for more efficient use of equipment	1
J. Report maintenance problems promptly	1
K. Unannounced inspection	1
L. "Warm-up" time minimized	1
M. Solar screens in all galley windows	1

APPENDIX G

Table G-2. LOCAL ADAPTIVE EFFORTS ON ENERGY CONSERVATION CURRENTLY IN USE

Navy Ships Surveyed

	No. of Ships
I. Does local training program include energy conservation?	
Yes	5
No	7
II. Are energy conservation measures being used locally?	
Yes	3
No	9
III. Specific energy conservation efforts currently being used:	
A. Conserve water	3
B. Turn off equipment when not needed	3
C. Turn off lights when not needed	1

APPENDIX G

Table G-3. LOCAL ADAPTIVE EFFORTS IN ENERGY CONSERVATION CURRENTLY IN USE

Army Land Installations Surveyed

	No. of Installations
I. Does local training program include energy conservation?	
Yes	26
No	4
No information given	2
II. Are energy conservation efforts being used locally?	
Yes	26
No	3
No information given	3
III. Specific energy conservation efforts currently being used:	
A. Turn off equipment when not needed	27

	No. of Installations
III. Specific energy conservation efforts currently being used: (Cont.)	
B. Unannounced inspection	12
C. Management and Personnel involvement	10
D. Turn off lights when not needed	5
E. Train personnel for proper use of equipment and ways to conserve energy	4
F. Turn off needless running water	3
G. Keep refrigerator doors closed	2
H. Report maintenance problems promptly	2
I. Wash loading docks with cold water	2
J. Minimize "Warm-up" time	1
K. Use small units when large units not needed	1

APPENDIX G

Table G-4. LOCAL ADAPTIVE EFFORTS ON ENERGY CONSERVATION CURRENTLY IN USE

Marine Corps Installations Surveyed

	No. of Installations
I. Does local training include energy conservation?	
Yes	18
No	5
II. Are energy conservation efforts being used locally?	
Yes	18
No	5
III. Specific energy conservation efforts being used:	
A. Turn off equipment when not needed	13
B. Turn of lights when not needed	11
C. Turn off needless running water	4
D. Keep refrigerators closed (doors are opened a minimum number of times)	3

	No. of Installations
III. Specific energy conservation efforts currently being used: (Cont.)	
E. Unannounced inspection	2
F. Use small unit when large unit not needed	1
G. Not using hot water to wash loading docks	1
H. Signs are posted to promote energy conservation	1
I. Report maintenance problems promptly	1
J. Menus are planned for more efficient use of equipment	1

APPENDIX H

DINING FACILITIES CONSERVATION STANDARDS

(Fort Leavenworth, Kansas)

1. General

a. Communicate to employees and assigned personnel the need to conserve energy.

b. Encourage employee car pools; use the telephone instead of a car whenever possible.

c. Minimize trips to ration distribution points by planned purchases of condiments and accessory foods concurrent with scheduled ration pickup.

2. Facilities

a. Consolidate dining facilities so that those dining facilities in operation are at near capacity.

b. Except when needed during serving and cleaning periods, dining room lights should be extinguished. When serving small groups of diners, only the portion of the dining room needed should be illuminated. Replace incandescent lighting with more efficient (low wattage) luminaries.

c. Close off and reduce heat in dining rooms not used on weekends or periods of reduced feeding strengths. Lower thermostats in all areas during nonoperating hours.

d. Insure windows and doors are closed during the heating season. Take advantage of sun-exposed areas by opening drapes and blinds. Drapes should be closed during night time hours.

e. Use windbreaks at entrances and exits to deflect wind and cold air from heated areas. Replace worn or missing weather stripping.

f. Eliminate or consolidate night feeding operations and review possibility of conducting night baker tasks during normal operational hours.

g. Repair water faucets promptly. Do not allow the continuous running of water in dishwashers, rinse sinks, or outside can washing areas.

h. Repair insulation on hot water pipes.

i. Limit general use hot water to 140°F; limit dishwasher rinse water to 180°F.

j. Use hot water for essential cleaning only; i.e., do not use hot water for hosing down exterior concrete pads.

k. Fill sinks for washing utensils instead of using continuous running water.

3. Refrigeration

a. Use refrigerated storage space to its capacity and disconnect all unused refrigerated equipment. Locate refrigeration equipment away from heat producing equipment.

b. Be certain door gaskets and seals on doorways to refrigerated or heated areas are intact and functioning properly.

c. Keep refrigerator and freezer doors closed as much as possible. Have stocks well organized in walk-in units. Know what you want before going in. Expedite receiving and prompt refrigeration of frozen and perishable foods.

d. Assure that lights are extinguished within refrigerated boxes and other work areas when not in actual use.

e. Maintain sufficient freon gas in all refrigerators and air conditioners. Keep refrigeration coils clean; defrost when build-up exeeds 1/4 inch.

4. Equipment

a. Turn off kitchen equipment when not in use or not required.

b. Purchase equipment of the proper size and capacity to handle the required load. Operate just part of a multiple-burner broiler or griddle during slow periods. When possible, use smaller, low wattage equipment: a pop-up toaster in place of the larger conveyor toaster for low volume meals, coffee makers in place of coffee urn, etc.

c. Have ovens, ranges, and grills calibrated. Require the use of oven, meat and deep-frying thermometers to preclude overheating. Turn thermostats on fryers down during slack periods.

d. Load and unload ovens quickly to avoid unnecessary heat loss.

e. Delime, descale, and clean heater coils in steam tables, dishwashers and coffee urns.

f. Turn off exhaust fans as soon as possible.

5. Field Operations

a. Review field feeding operational procedures, insuring cooks are instructed in proper maintenance and refueling procedures. Fire units should not be used for heating of tents or sleeping areas. Fire units and heaters should be ignited only when necessary. Care should be taken to regulate fuel to obtain desired heat only. Use of funnesl and nozzles for refilling of fuel tanks is essential. Gasoline must not be used for cleaning field equipment.

b. Ensure that a burner and four sections of stove pipe are installed on immersion heater to minimize fuel consumption and maximize heat output.

c. Avoid needless idling of engines. Do not use vehicle air compressor to pump up burner units.

APPENDIX I

Table I-1. REASONS FOR EQUIPMENT CONSUMING AN UNUSUALLY LARGE AMOUNT OF ENERGY

Navy Land Installations surveyed

	No. of Installations
I. Is an unusually large amount of energy consumed?	
Yes	8
No	33
No information given	3
II. Specific reasons why equipment consumes an unusually large amount of energy.	
A. Public Works Department slow to make necessary repairs	5
B. Thermostat controls do not work properly	3
C. Freezer door seals poorly	1
D. Dishwashing machine is malfunctioning	1
E. Windows opened with air-conditioning on	1

	No. of Installations
II. Specific reasons why equipment consumes an unusually large amount of energy. (Cont.)	
F. Ovens take too long to preheat	1

APPENDIX I

Table I-2. REASONS FOR EQUIPMENT CONSUMING AN UNUSUALLY LARGE AMOUNT OF ENERGY

Navy Ships Surveyed

	No. of Ships
I. Is an unusually large amount of energy consumed?	
Yes	2
No	8
No information given	2
II. Specific reasons why equipment consumes an unusually large amount of energy.	
A. Ovens and grills not properly calibrated	1
B. Leaking spigots from water inlets	1
C. Walk-in reefer boxes	1

APPENDIX I

Table I-3. REASONS FOR EQUIPMENT CONSUMING AN UNUSUALLY LARGE AMOUNT OF ENERGY

Army Land Installations Surveyed

	No. of Installations
I. Is an unusually large amount of energy consumed?	
Yes	9
No	17
No information given	6
II. Specific reasons why equipment consumes an unusually large amount of energy.	
A. Equipment is old	3
B. Dishwashing machine is malfunctioning	3
C. Thermostat controls do not work properly	3
D. Equipment not being turned off when not in use	2
E. Equipment not being used properly	1

Table I-4. REASONS FOR EQUIPMENT CONSUMING AN UNUSUALLY LARGE AMOUNT OF ENERGY

Marine Corps Installations Surveyed

	No. of Installations
I. Is an unusually large amount of energy consumed?	
Yes	7
No	16
II. Specific reasons why equipment consumes an unusually large amount of energy.	
A. Due to old equipment	2
B. Oven doors do not close properly	1
C. Facility engineers slow to make necessary repairs	1
D. Freezer door seals poorly	1
E. Dishwashing machine is malfunctioning	1
F. Electric steam line is not an economical source of heat	1

APPENDIX J

Table J-1. SUGGESTIONS IN AREAS WHERE ENERGY SAVINGS CAN BE ACHIEVED

Navy Land Installations Surveyed

	No. of Installations
I. Can you suggest an area where energy savings can be achieved?	
Yes	34
No	2
No information	8
II. Suggestions on energy savings	
A. Turn off unnecessary equipment and lights	13
B. Proper upkeep and increased scope of maintenance procedures	10
C. Use more efficient equipment	8
D. Good training program for food service personnel	5
E. Use microwave ovens	3
F. Close supervision by key personnel	2
G. Use stack ovens instead of revolving ovens	2

	No. of Installations
II. Suggestions on energy savings: (Cont.)	
H. Don't turn on equipment too early	2
I. Wall posters to promote conservation	2
J. Photocells or timers to turn off lights	1
K. Stress proper procedures of cooking	1
L. Review master menu and eliminate food requiring long cooking time	1
M. Lower ceilings to increase efficiency of air-conditioning	1
N. Do not overload equipment	1
O. Use gas oven instead of electric oven	1
P. Install double-door entrances	1
Q. Reduce size and hours of operation	1
R. Coordinate the use of high energy consuming equipment	1

APPENDIX J

Table J-2. SUGGESTIONS IN AREAS WHERE ENERGY SAVINGS CAN BE ACHIEVED

Navy Ships Surveyed

	No. of Ships
I. Can you suggest an area where energy savings could be achieved?	
Yes	4
No	2
No information given	6
II. Suggestions in energy savings:	
A. Use of microwave equipment	2
B. Redesign of ship's galley	1
C. Use of frozen foods - individual packs ready to serve	1
D. Properly training personnel on conserving energy	1
E. Properly securing galley	1

APPENDIX J

Table J-3. SUGGESTIONS IN AREAS WHERE ENERGY SAVINGS CAN BE ACHIEVED

Army Land Installations Surveyed

	No. of Installations
I. Can you suggest an area where energy savings can be achieved?	
Yes	26
No	1
No information given	5
II. Suggestions on energy savings:	
A. Training program for food service personnel	9
B. Use more energy efficient equipment	8
C. Close supervision by key personnel	7
D. Turn off unnecessary equipment and lights	6
E. Proper upkeep and increased scope of maintenance procedures	6
F. Use consolidated mess hall	3

	No. of Installations
II. Suggestions on energy savings: (Cont.)	
G. Cut out long-cooking foods	3
H. Do not turn on equipment too early	2
I. Use canned products instead of frozen products	1
J. Coordinate the use of high energy consuming equipment	1

APPENDIX J

Table J-4. SUGGESTIONS IN AREAS WHERE ENERGY SAVINGS CAN BE ACHIEVED

Marine Corps Installations Surveyed

	No. of Installations
I. Can you suggest areas where energy savings can be achieved?	
Yes	21
No opinion	2
II. Suggest areas where energy savings can best be achieved:	
A. Use more efficient equipment	6
B. Good training program for food service personnel	6
C. Close supervision by key personnel	5
D. Consolidate messes	3
E. Turn off unnecessary equipment and lights	2
F. Proper upkeep and increase scope of maintenance procedures	2

	No. of Installations
II. Suggest areas where energy savings can best be achieved: (Cont.)	
G. Stress proper procedures of cooking	2
H. Use prepackaged convenience foods	2
I. Photocells or timers to turn off lights	1
J. Serve more cold meals	1
K. Review master menu and eliminate foods requiring long cooking time	1
L. Use stack oven instead of revolving ovens	1
M. Use gas grills instead of electric broilers	1
N. Buy baked goods on open markets	1
O. Have several separate circuits for lights	1
P. Wall posters to promote conservation	1